

Active Region Jets II: Triggering and Evolution of Violent Jets

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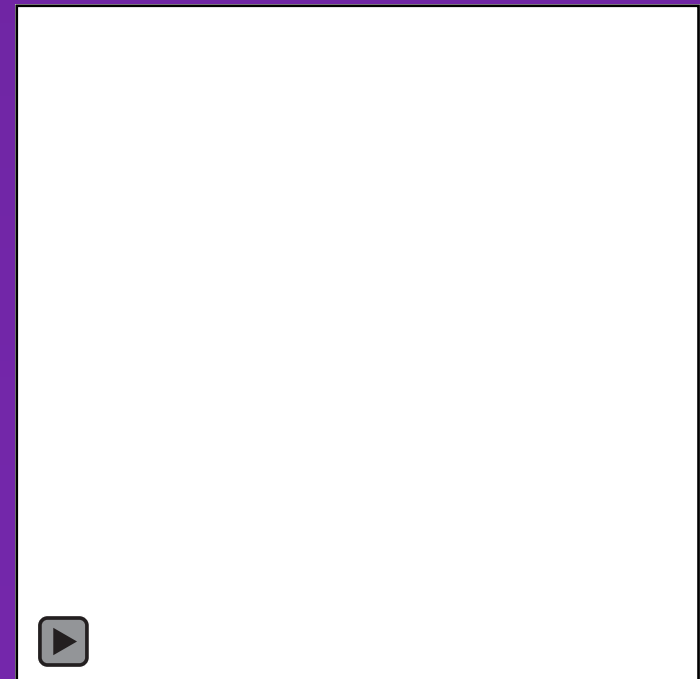
Supported by NASA's LWS and HGI programs, NASA NPP program, and MSFC/Hinode project.)

Introduction

- ♦ Coronal jets are well seen in X-rays and in EUV (e.g., Shibata et al. 1992, Shimojo et al. 1994, Cirtain et al. 2007, Nisticò et al. 2009, Raouafi et al. (2016).
- ♦ Often have a “jet bright point” on one side of the jet’s base.
- ♦ Seen in coronal holes, quiet Sun, and active regions.
- ♦ AR jets are similar in appearance to non-AR jets; AR jets are longer and more energetic. *But are they really the same as non-AR jets?*



Cirtain et al. (2007)



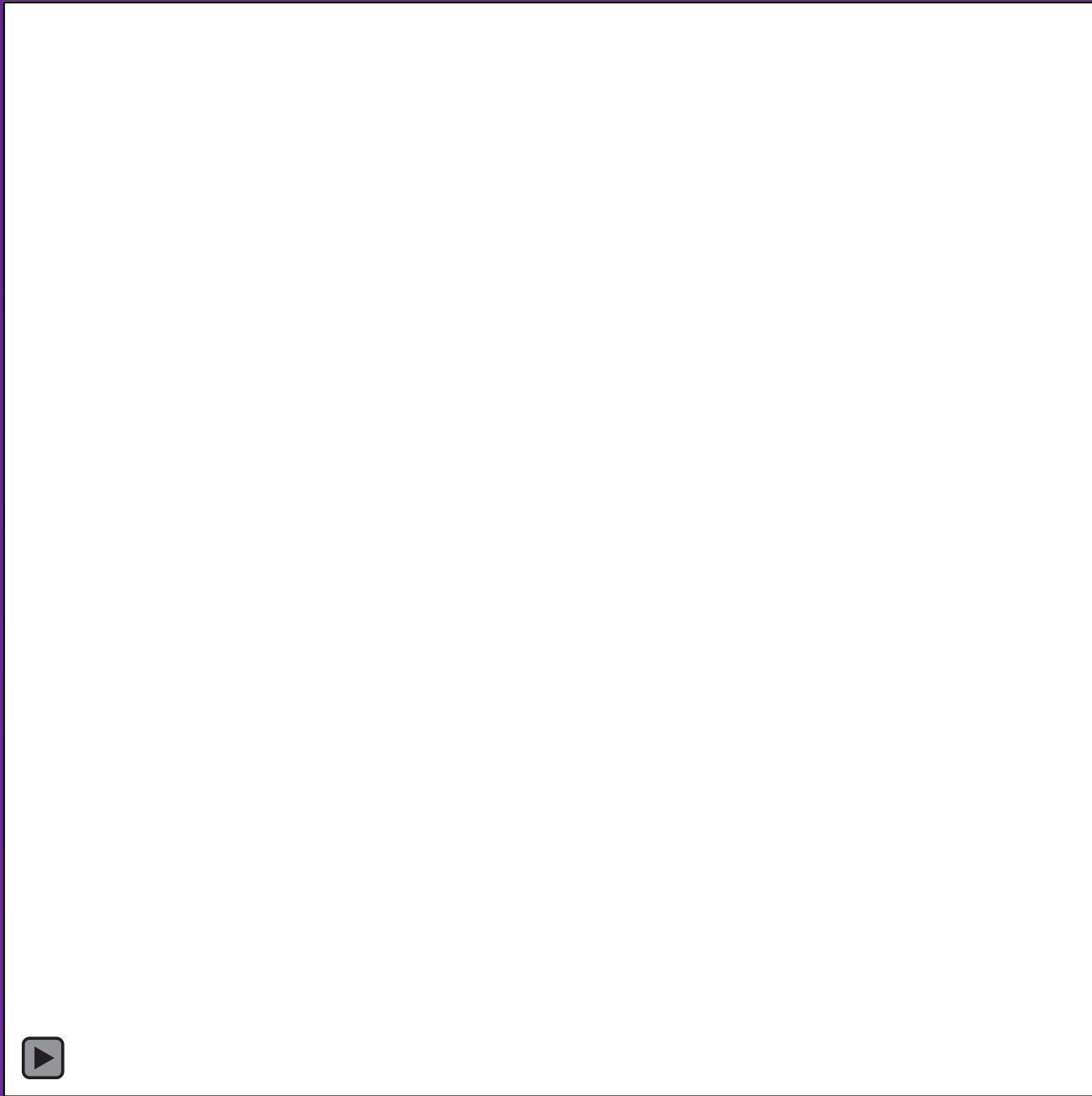
(Thanks to K. Reeves)

Main Points:

- ♦ AR jets are basically the same as non-AR jets; they all fit the “minifilament eruption” magnetic geometry.
- ♦ But, one difference is that frequently a cool minifilament is not apparent in (violent) AR jets.
- ♦ Why not?? Maybe it is hidden by surrounding bright material.

Coronal Hole Jets

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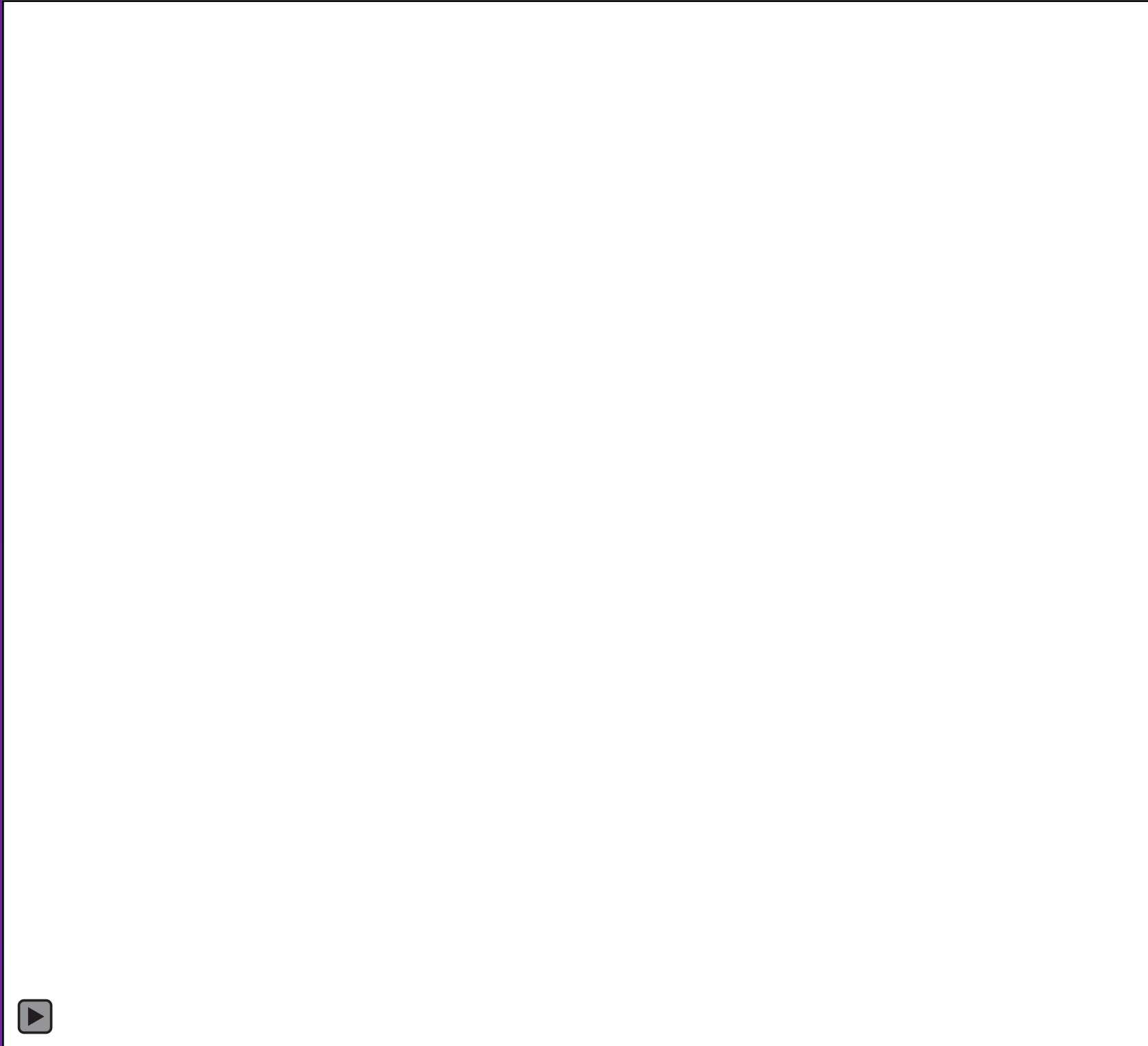


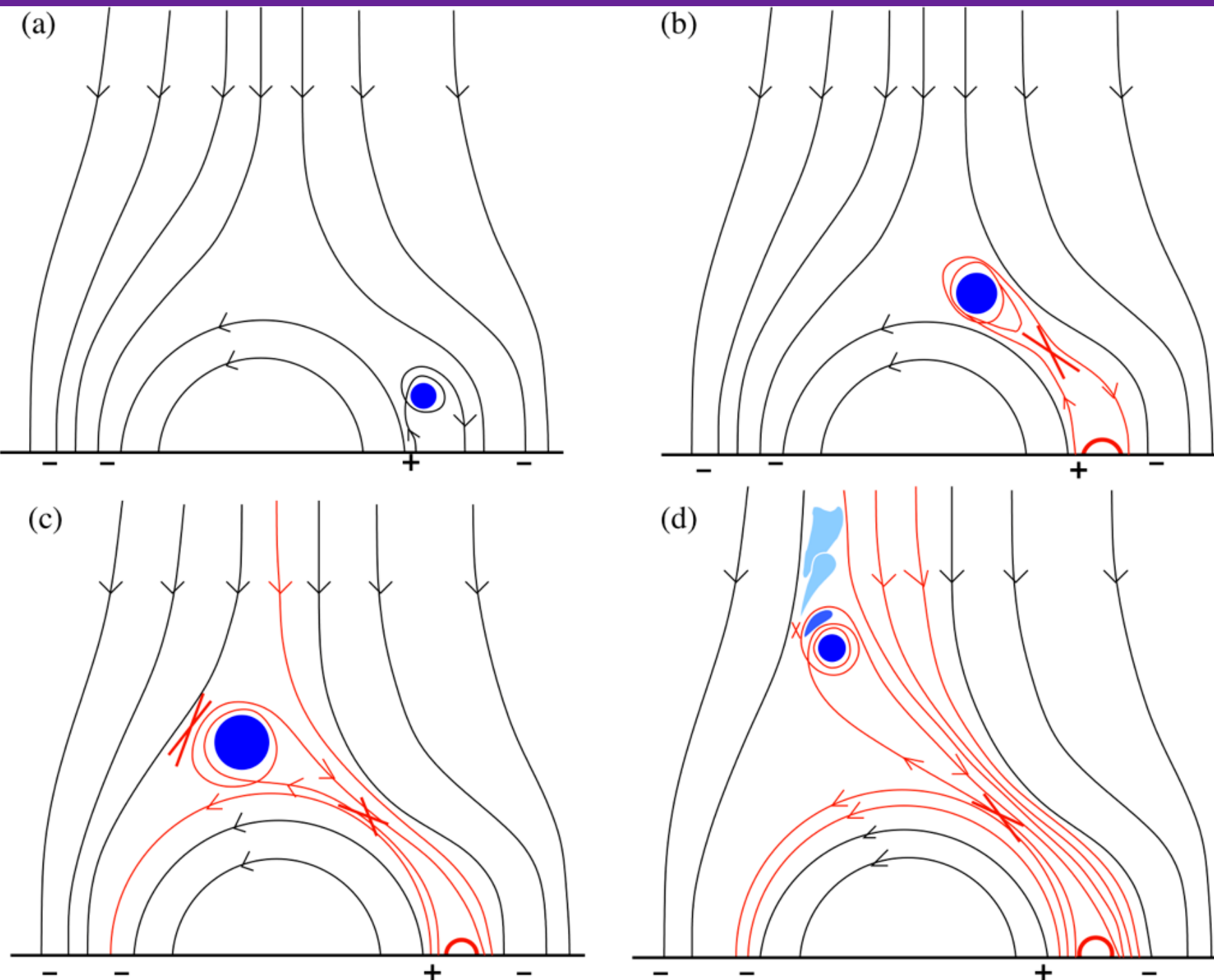
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Sterling et al. (2015)

“Normal” Filament Eruption (TRACE)





Sterling et al. (2015, 2016): “minifilament” eruptions.

Quiet Sun Jets — Similar to CH jets

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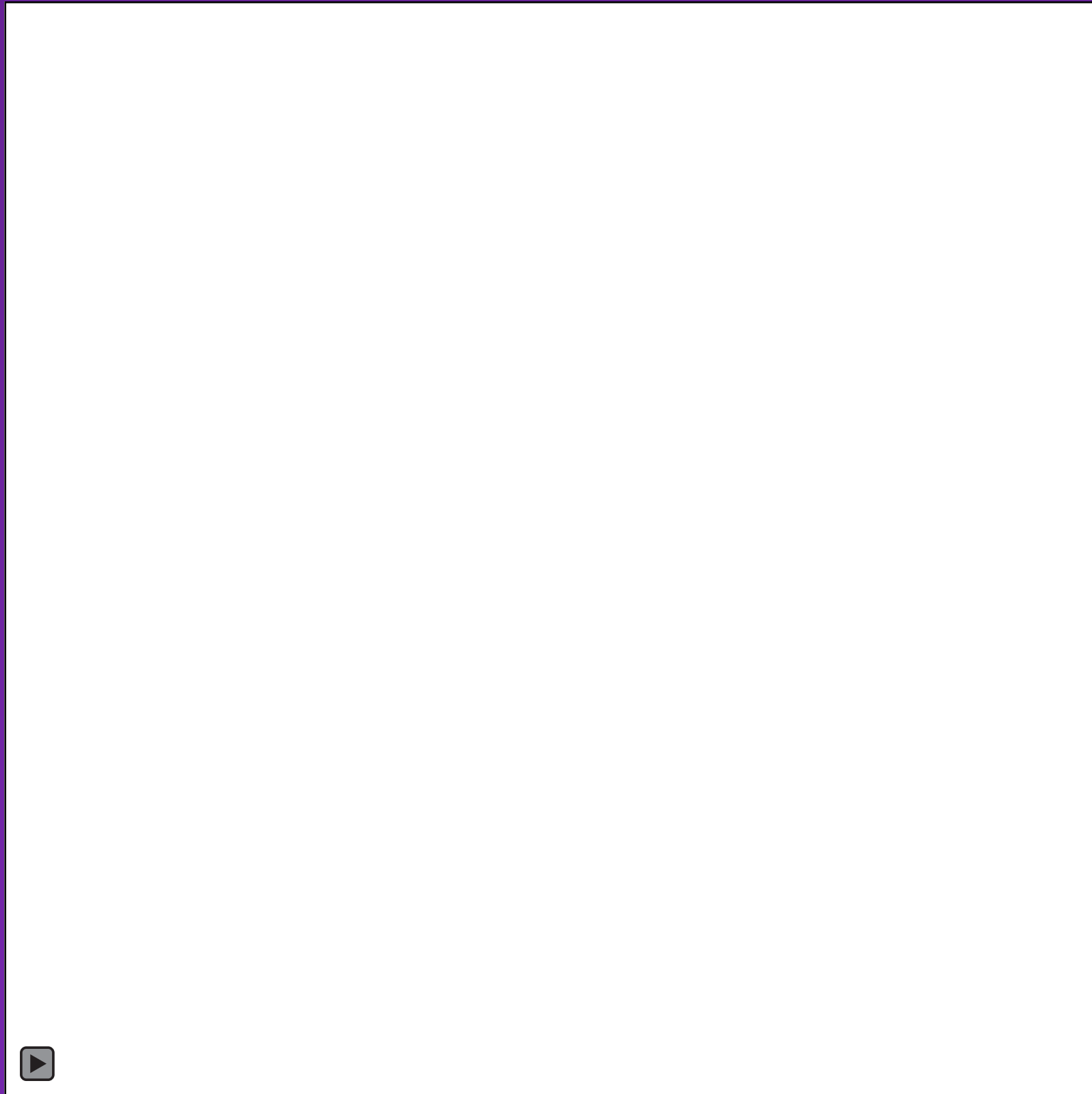
(Panesar et al. 2016, ApJL; 10 quiet Sun jets)₇

Active Region Jets: Sterling et al. (2016)

Results:

- Some AR jets show clear minifilaments; they are slowly developing, less “violent.” Serge-like, with weak X-ray signature.
- Other jets show little/no minifilaments; rapidly developing, more violent. Have strong X-ray signature

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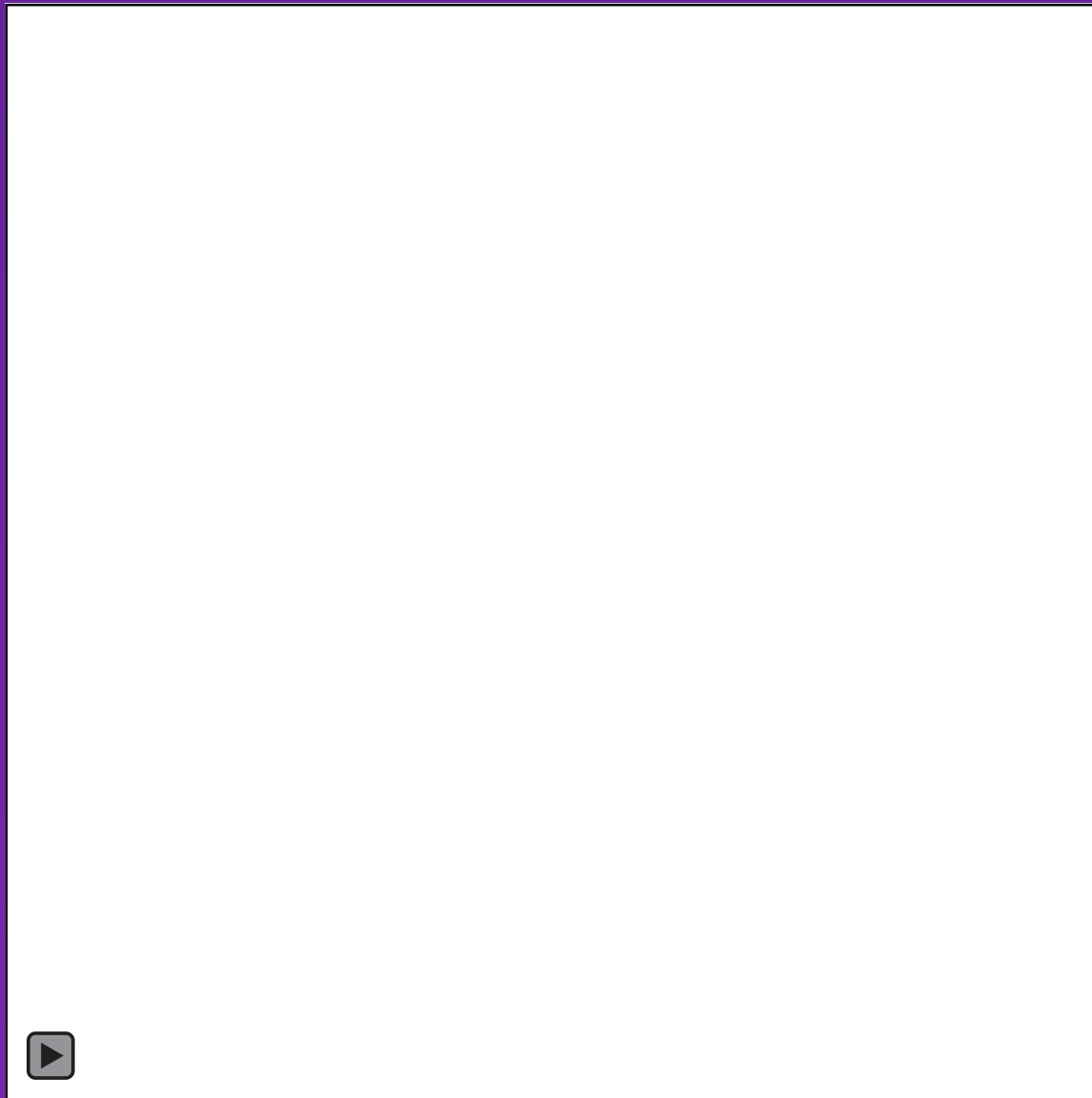
Sterling et al. (2016, ApJ)

Active Region Jets - Further investigations

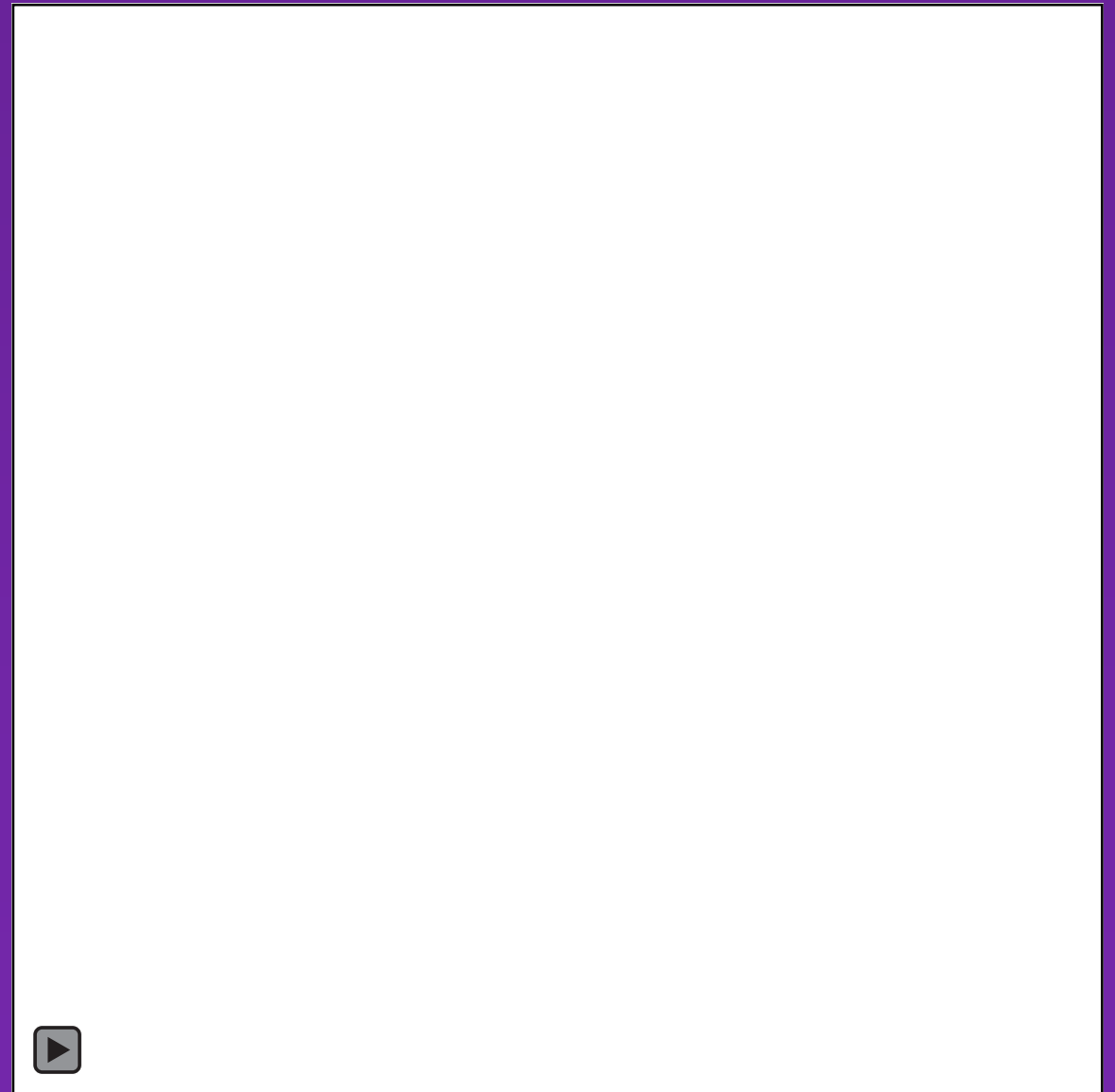
(Sterling, Moore, Falconer, Panesar, & Martinez
2017, ApJ)

AR Jet Example 2: To investigate further, look at a

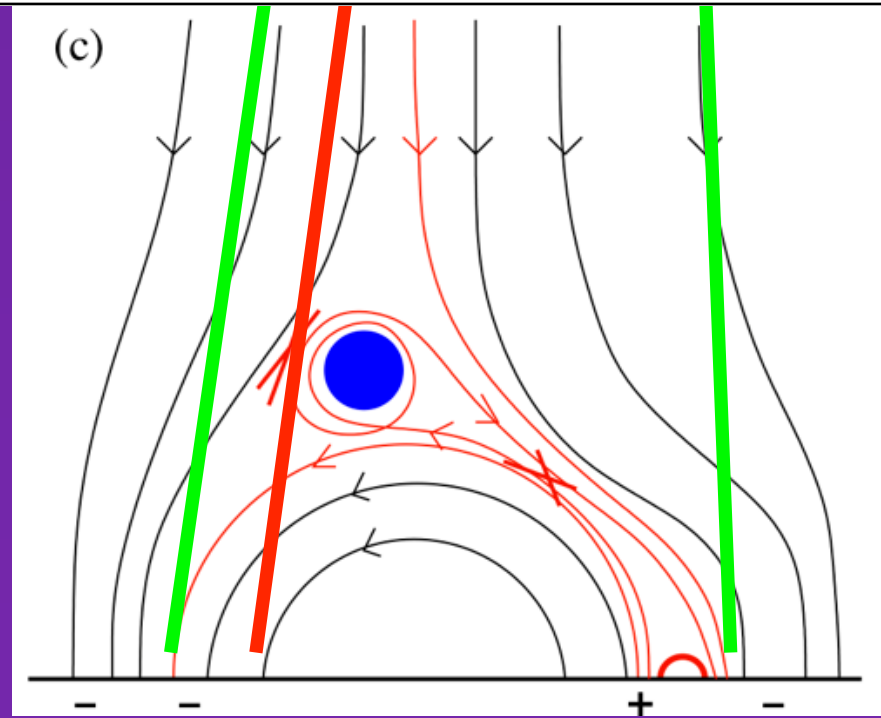
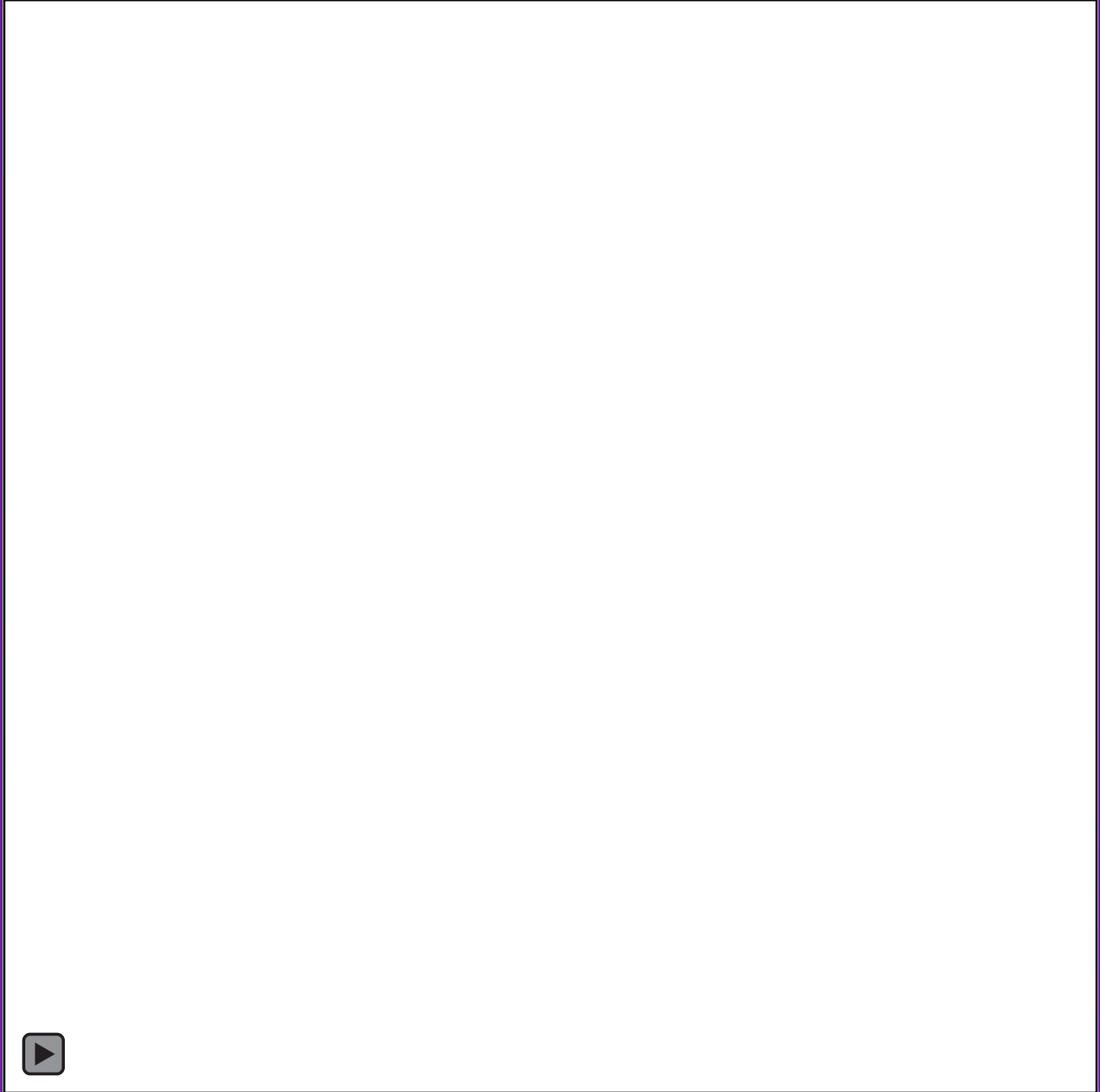
- different AR — Many violent jets:
14 Jan 2015 (NOAA AR 12259).
- AIA, HMI, Hinode, IRIS



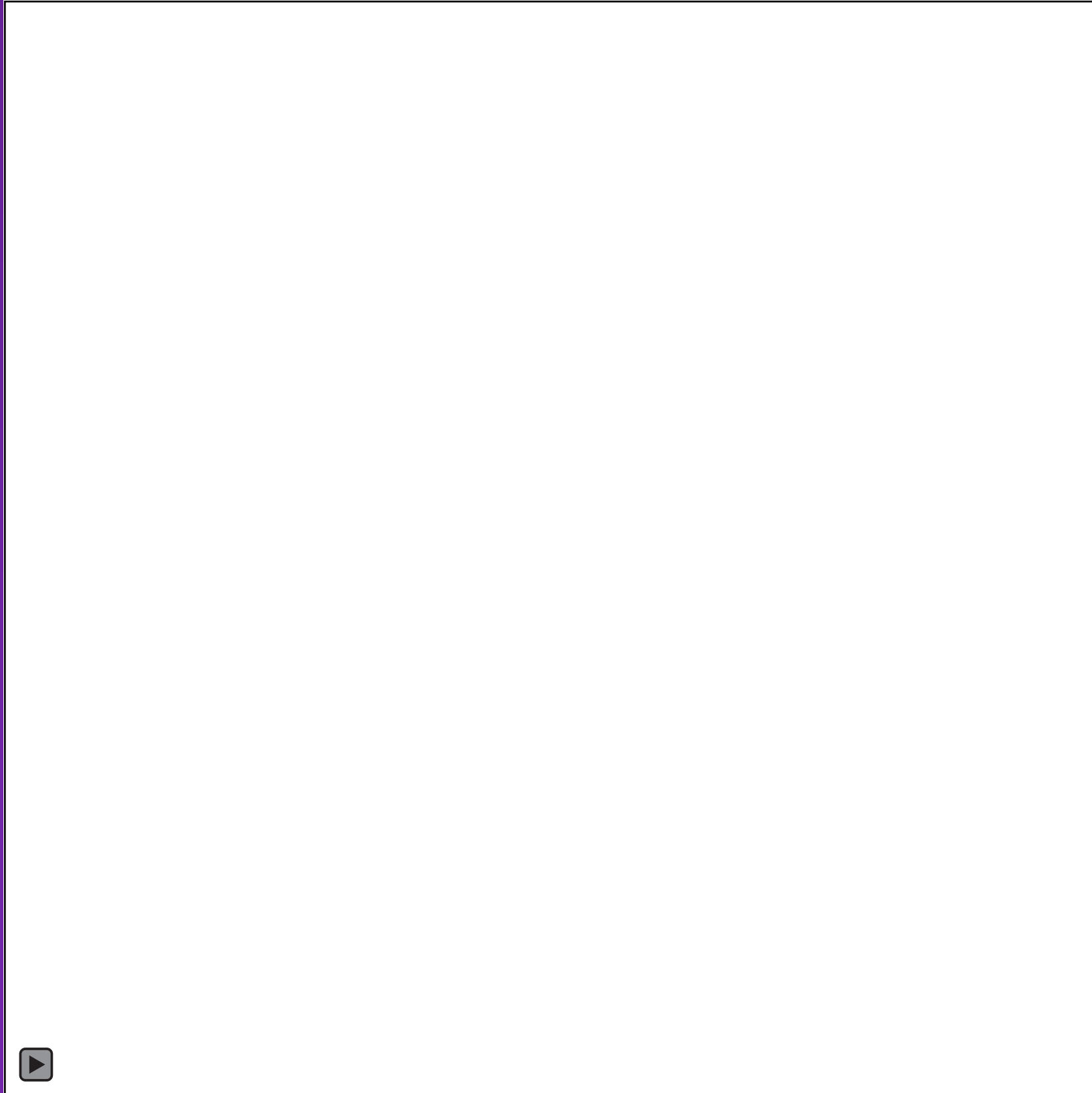
Hinode/XRT

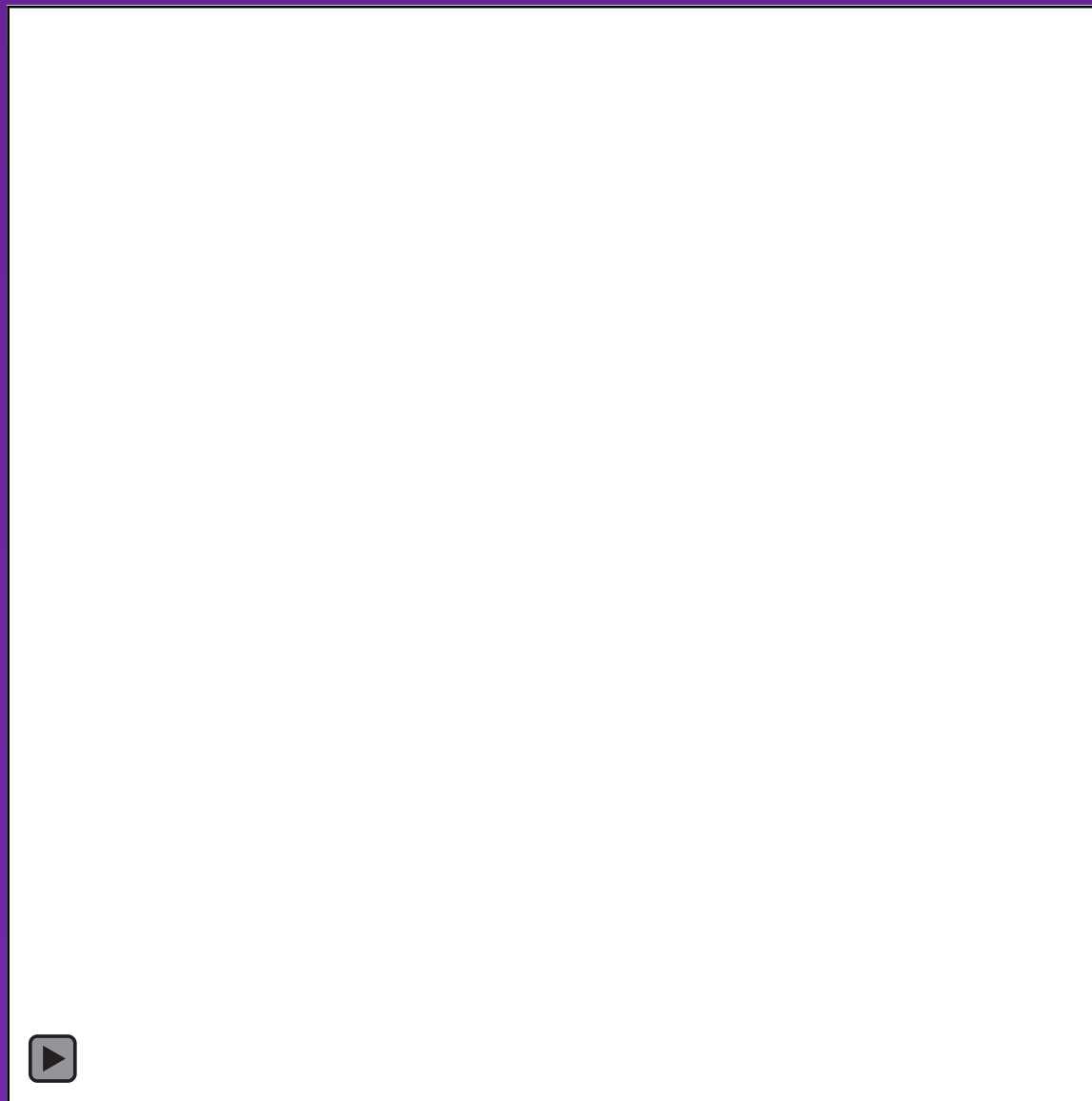


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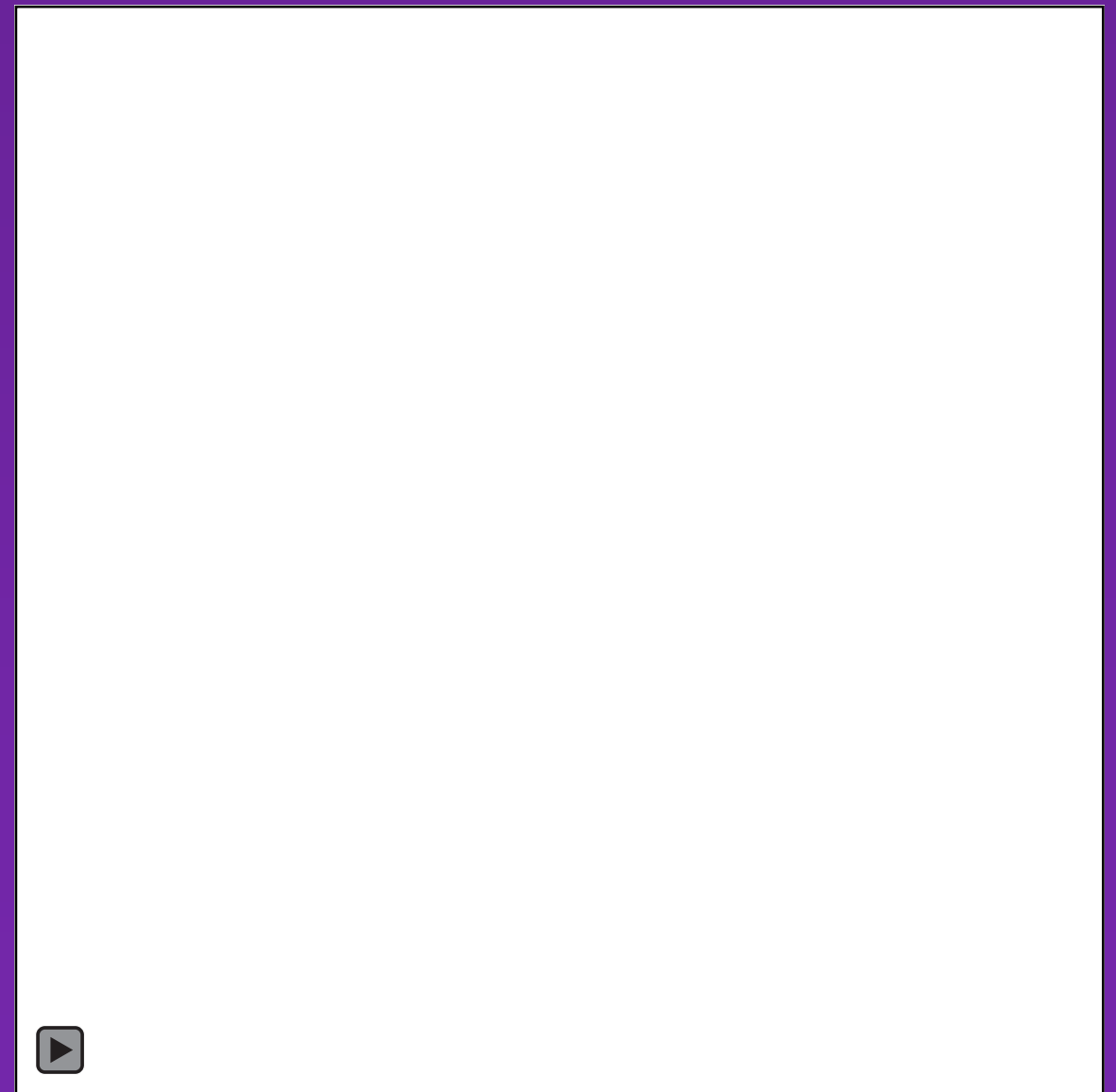


Is cool minifilament material hidden by a bright shell?



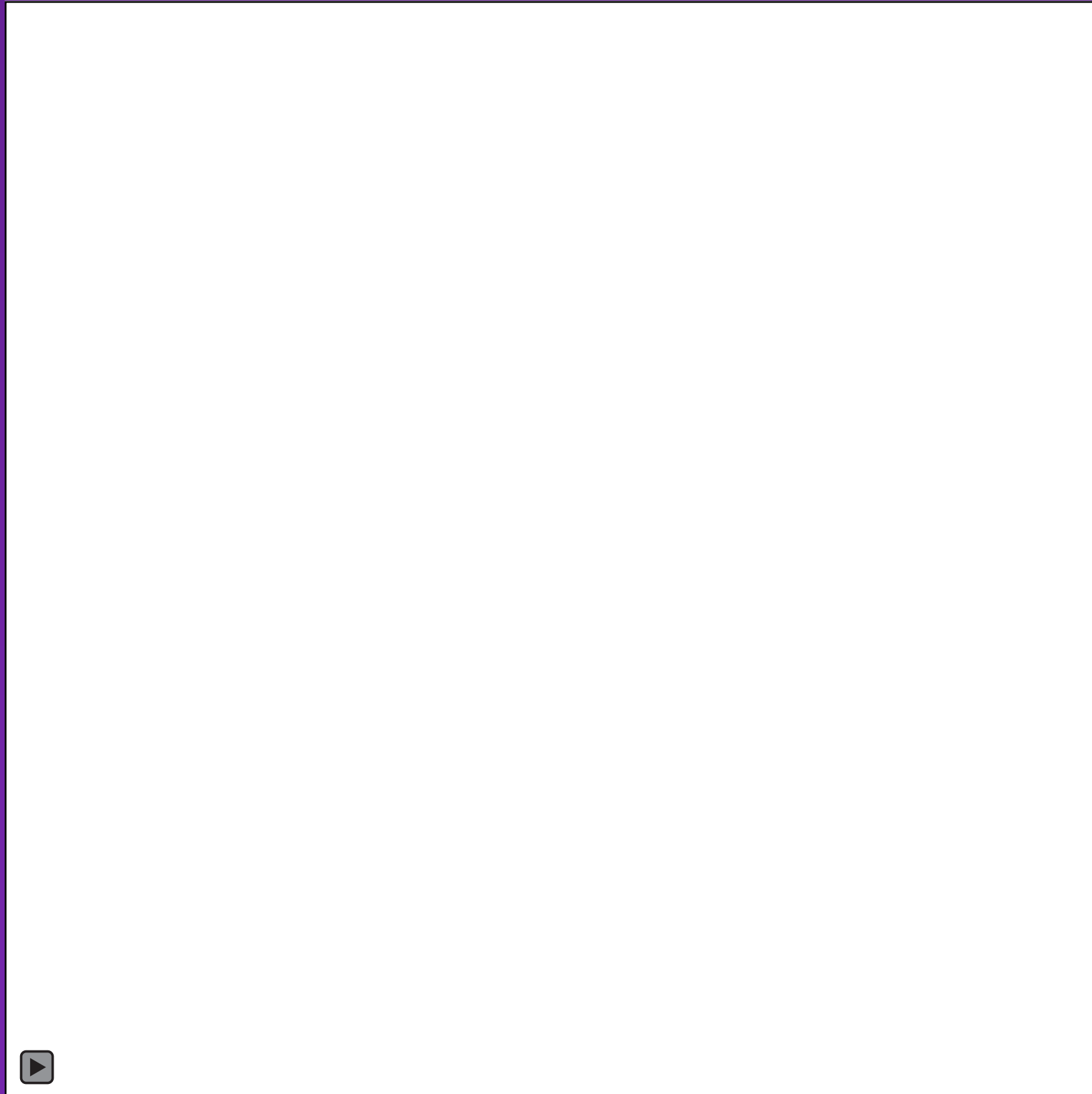


Hinode/XRT

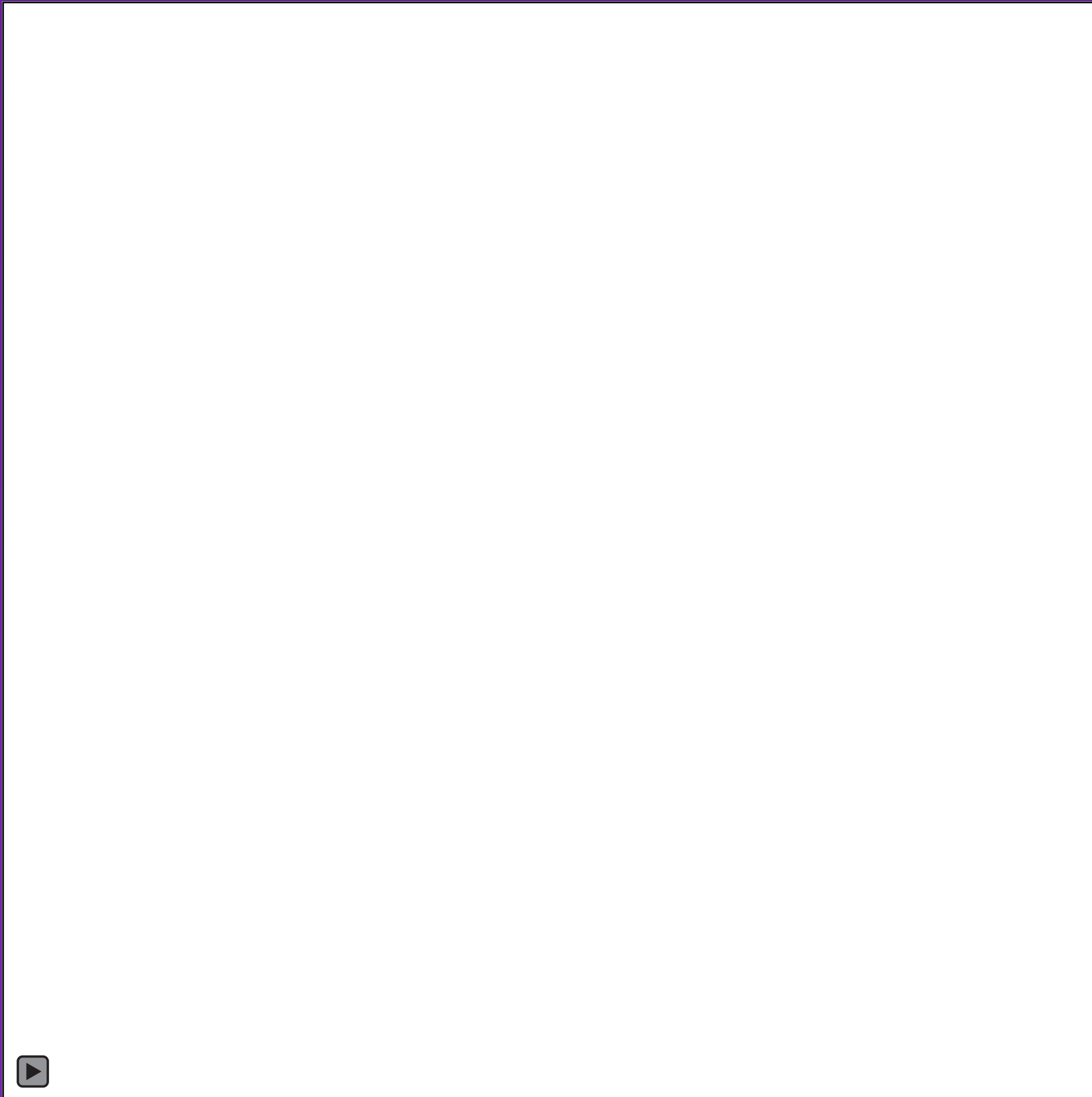


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Minifilament “strand” visible from neighboring region, slightly different time



Bright filament “cocoons” envelope some
“normal” large-scale eruptions too:



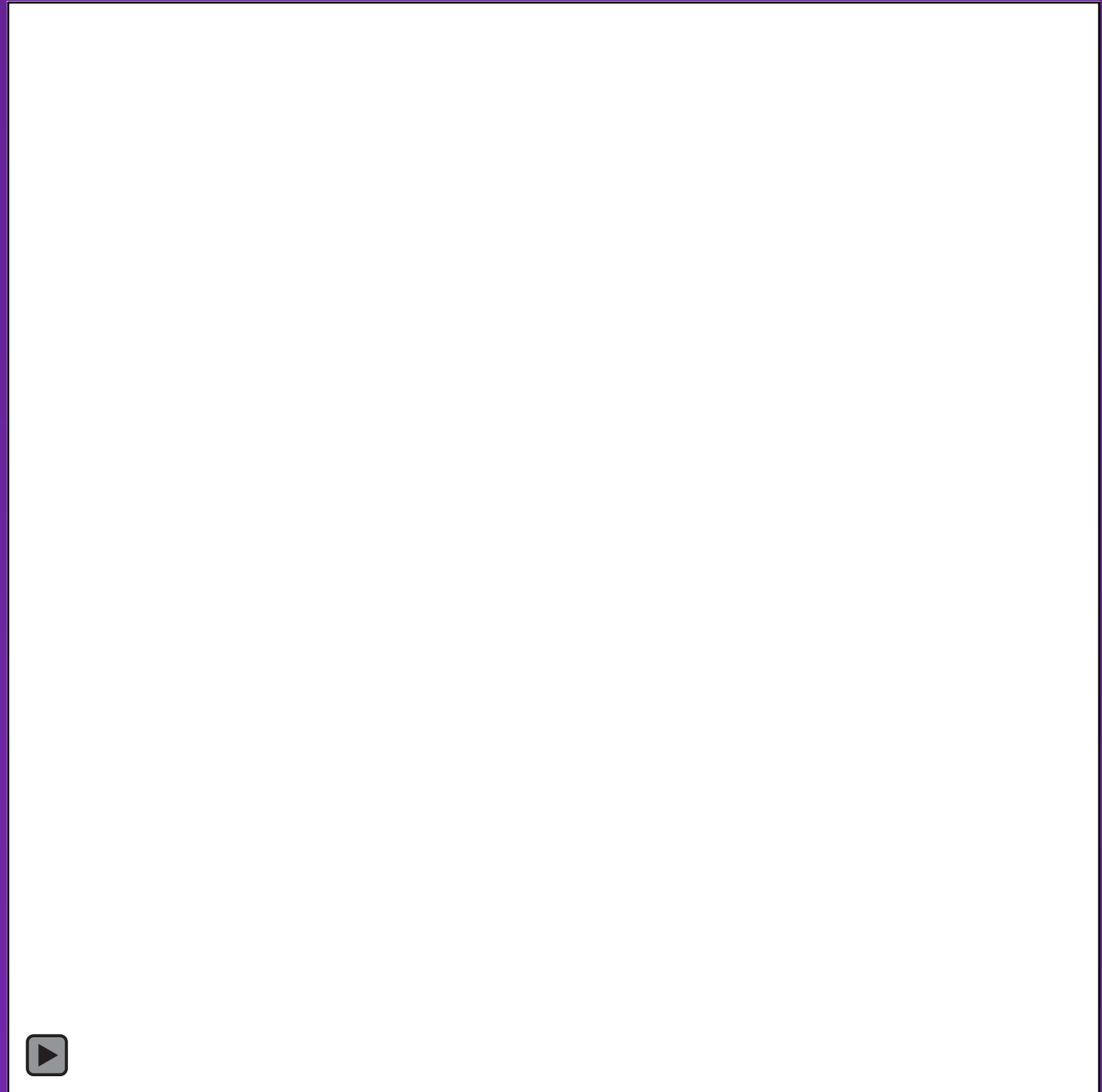
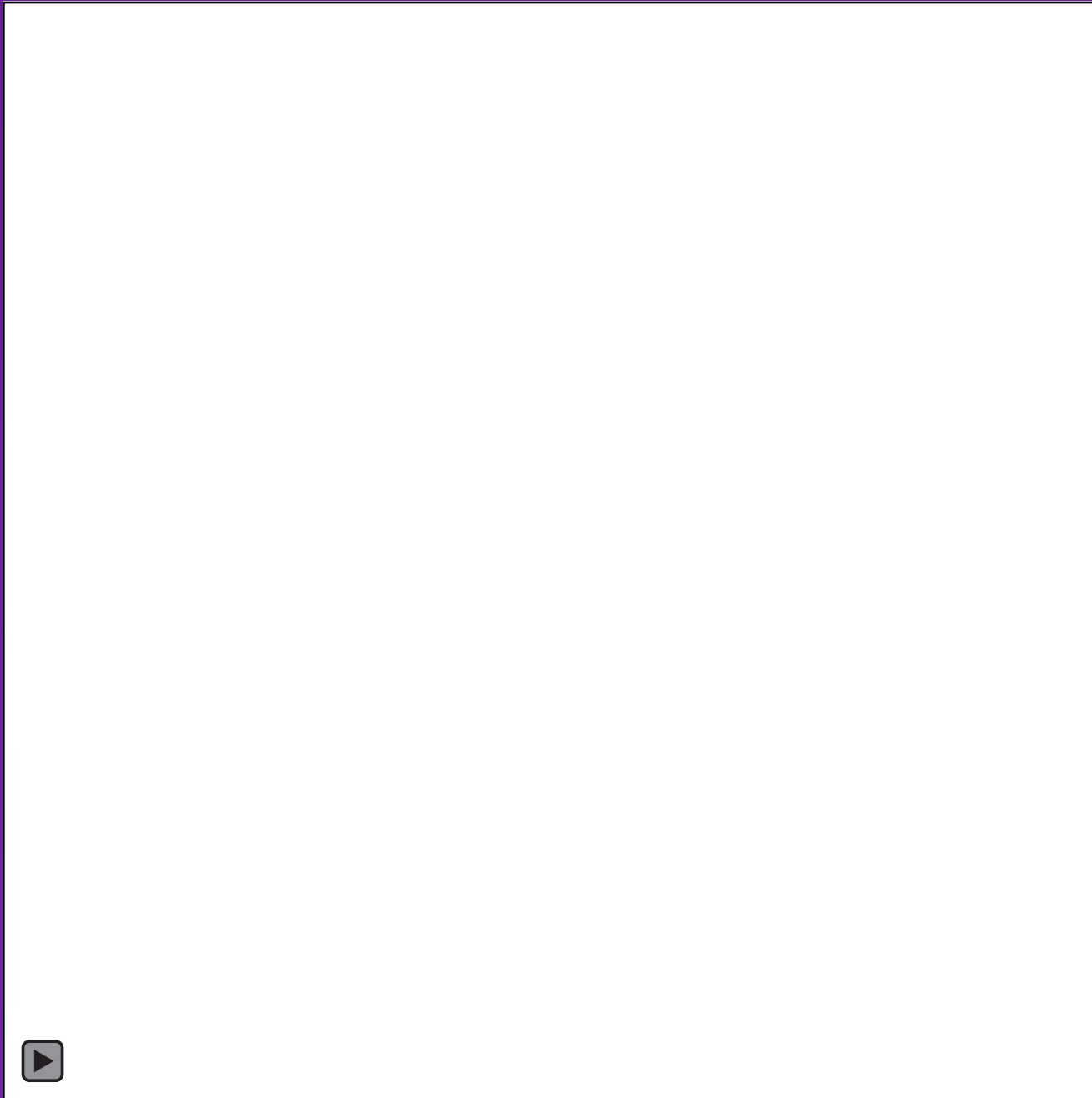
Summary and Conclusions

Detailed investigations of several AR jets (~ 10):

- ♦ All occur on neutral lines.
- ♦ Visually all fit the minifilament-eruption magnetic-field setup.
- ♦ Slower-buildup ones have obvious erupting minifilaments.
- ♦ Faster-buildup ones may have erupting minifilaments, but thinner, and maybe hidden by emission (cocoon and/or bright jet spire).

XRT

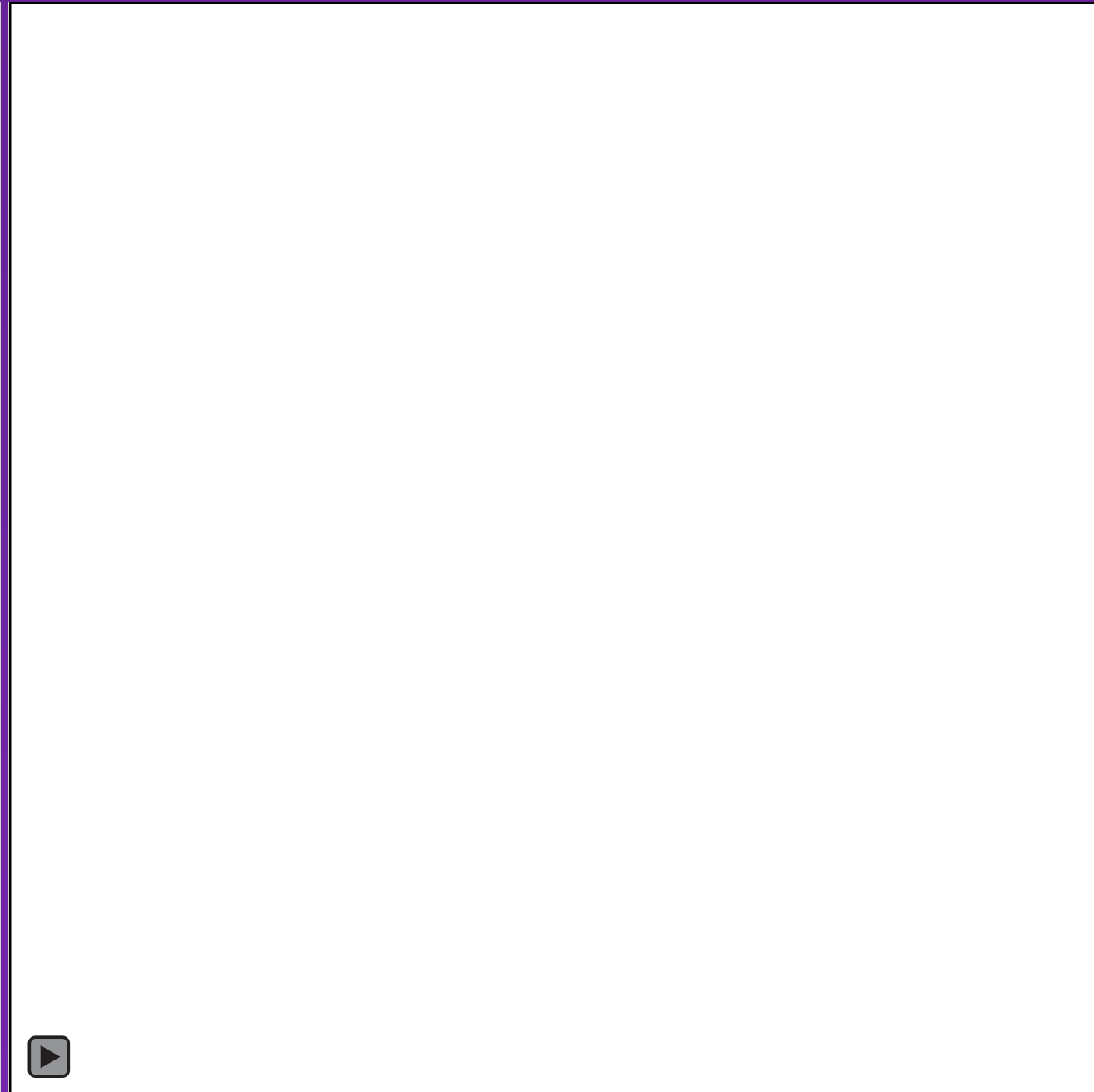
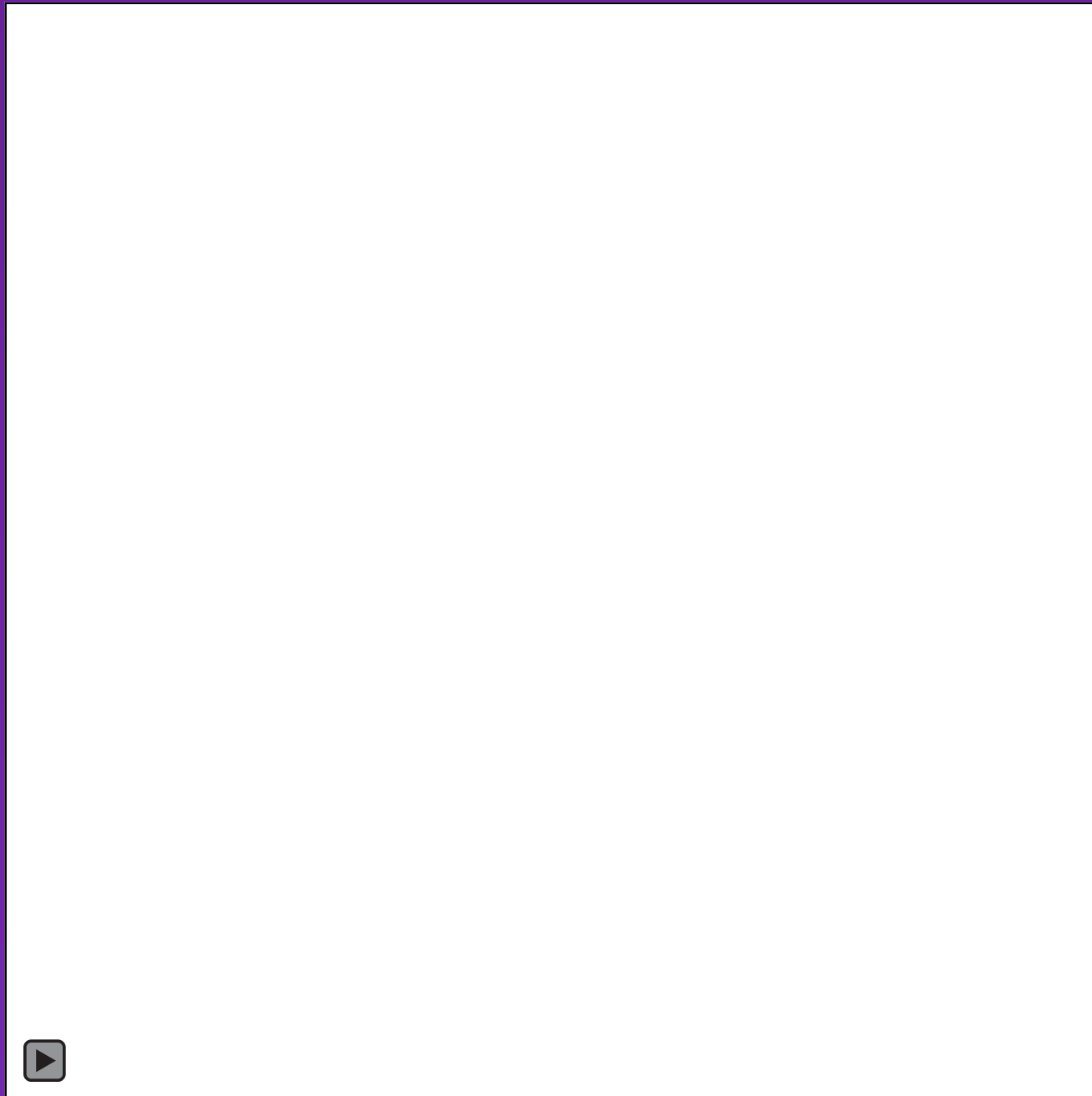
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Event 3

XRT

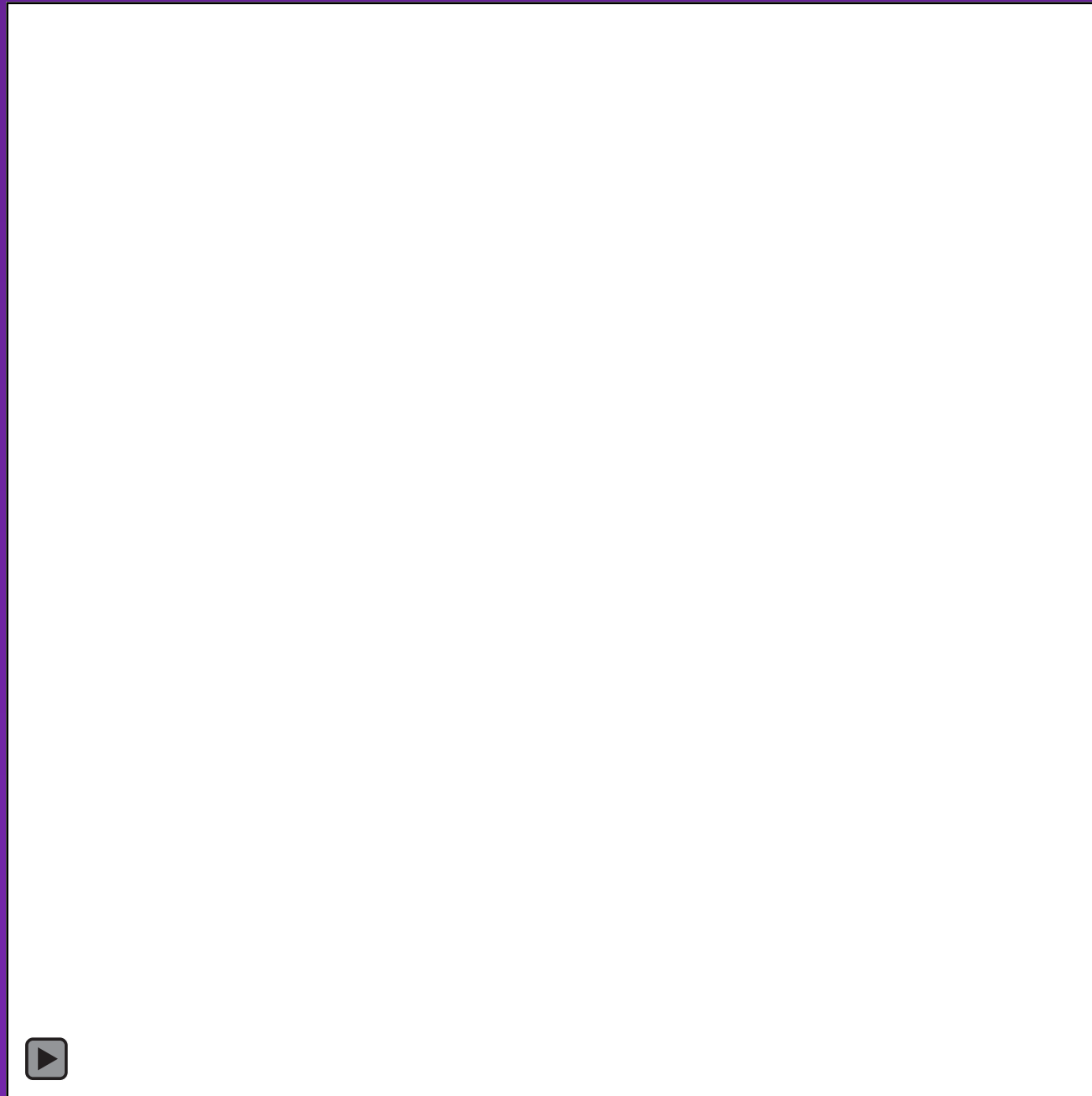
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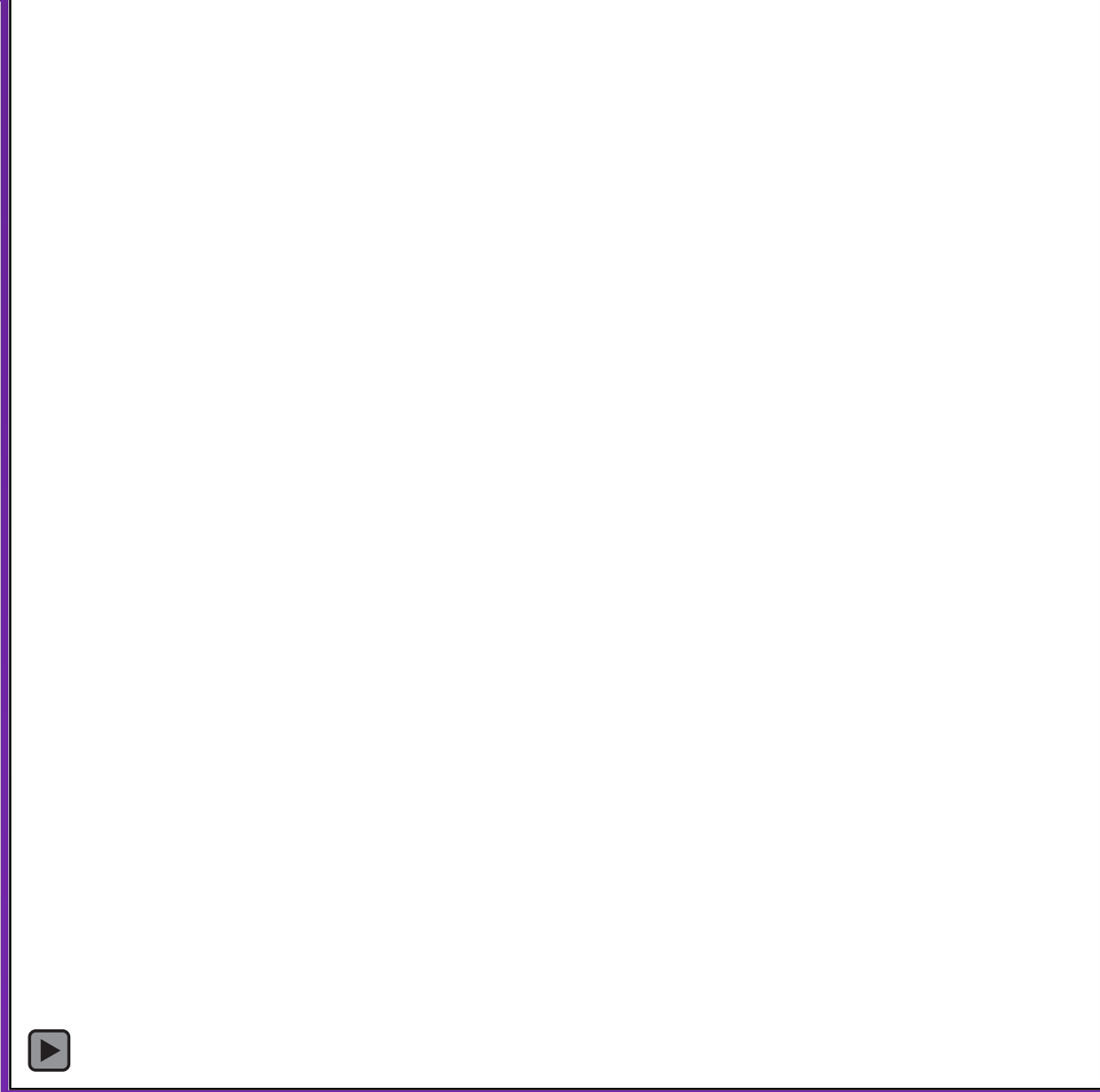
Event 12

Coronal Hole Jets: “Minifilament eruptions”

XRT

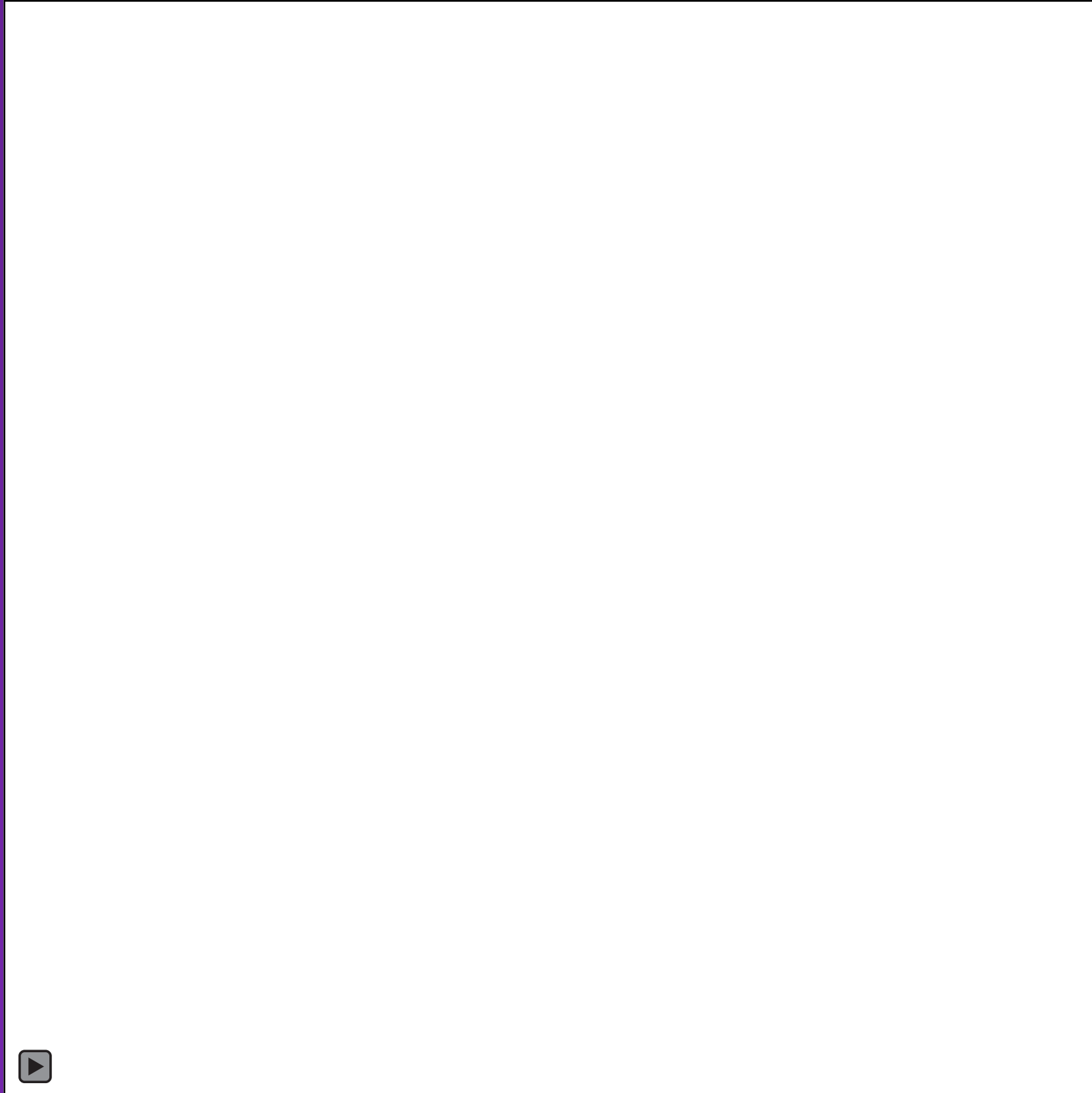


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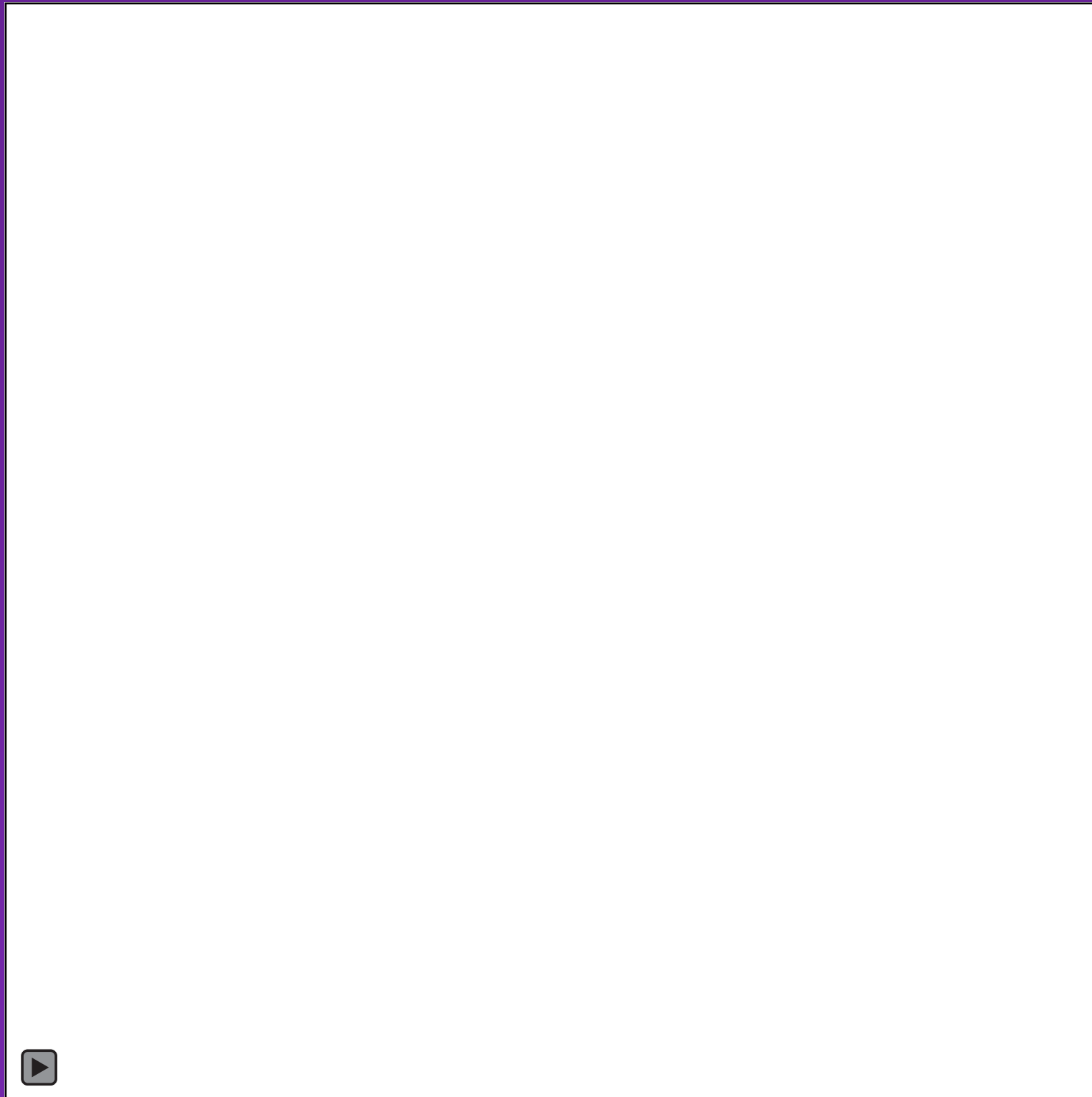


Sterling et al. (Nature, 2015): 20 Polar CH jets.

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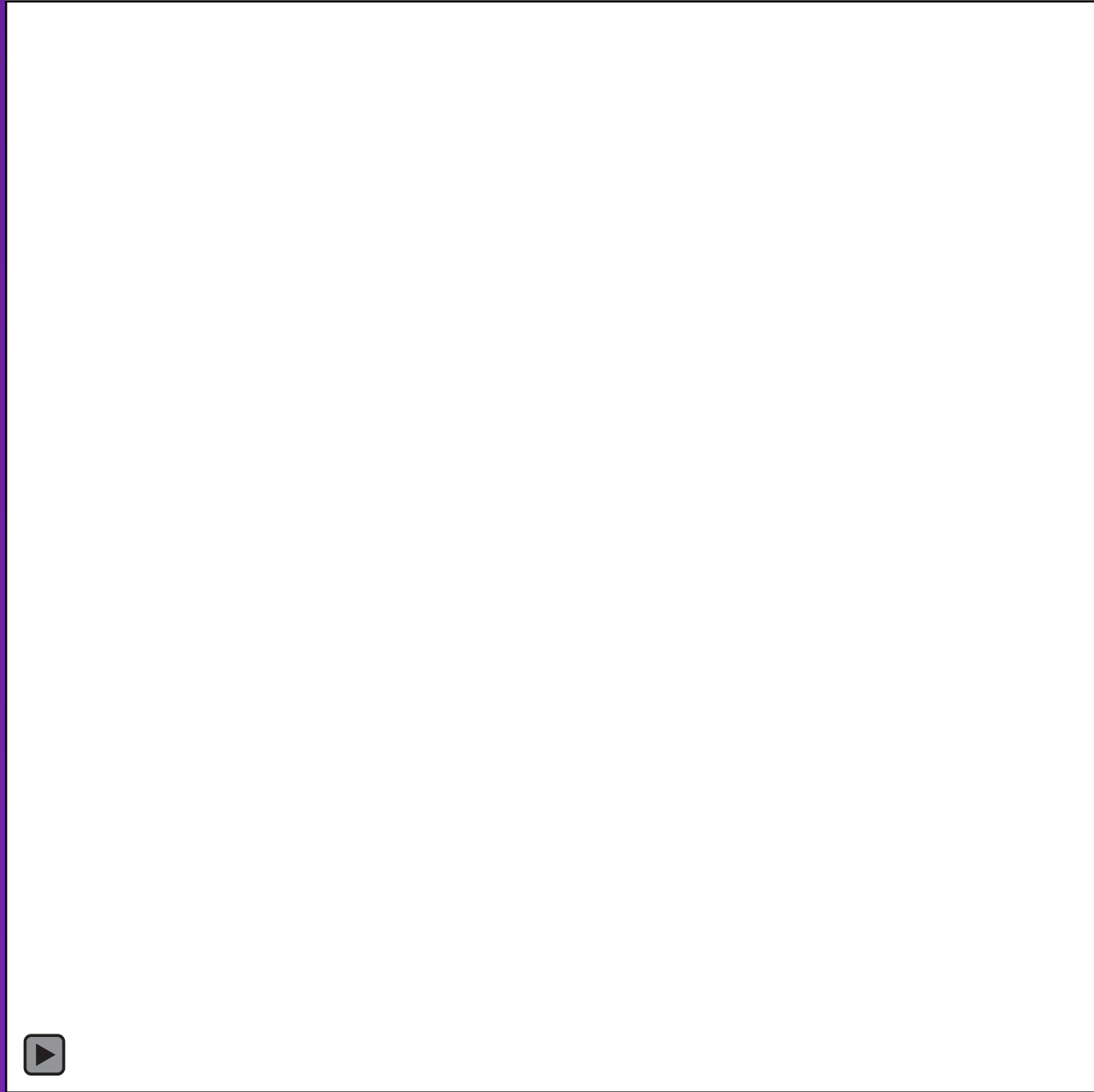


HMI of IRIS-observed region:

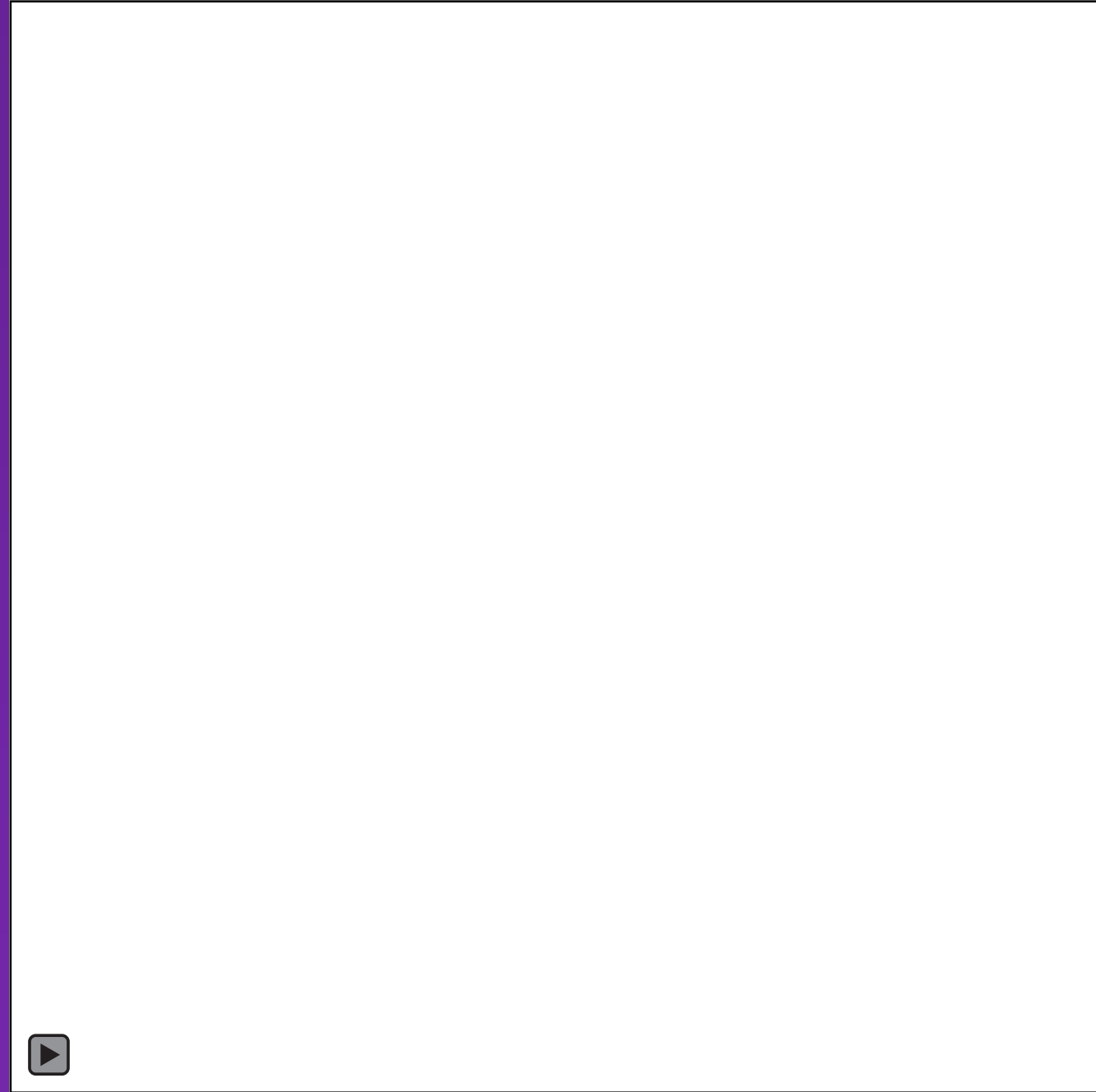


Jets occur at *flux cancelation* locations!





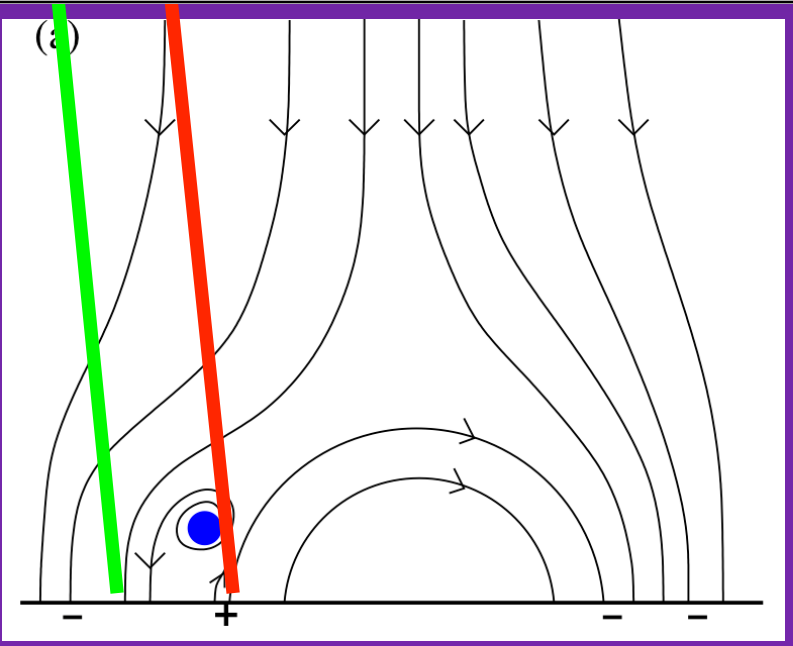
AIA 304



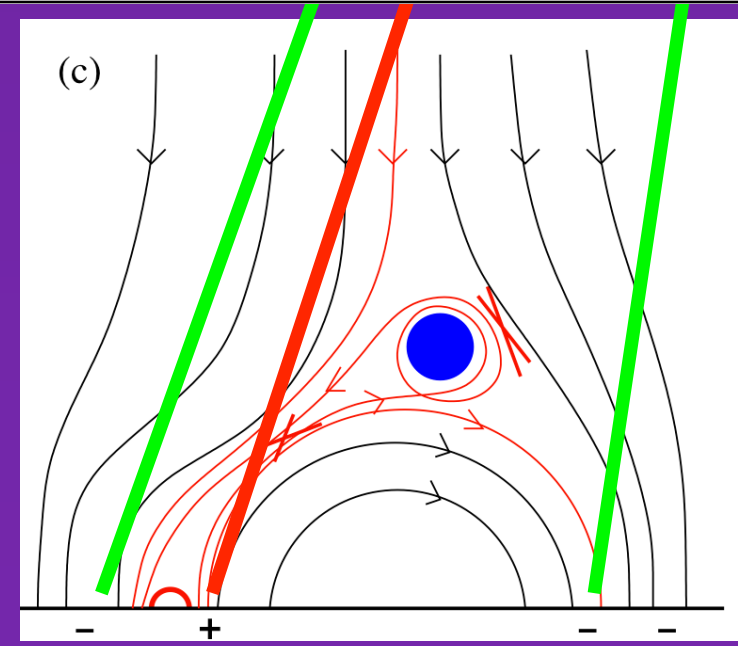
AIA 94



AIA 304

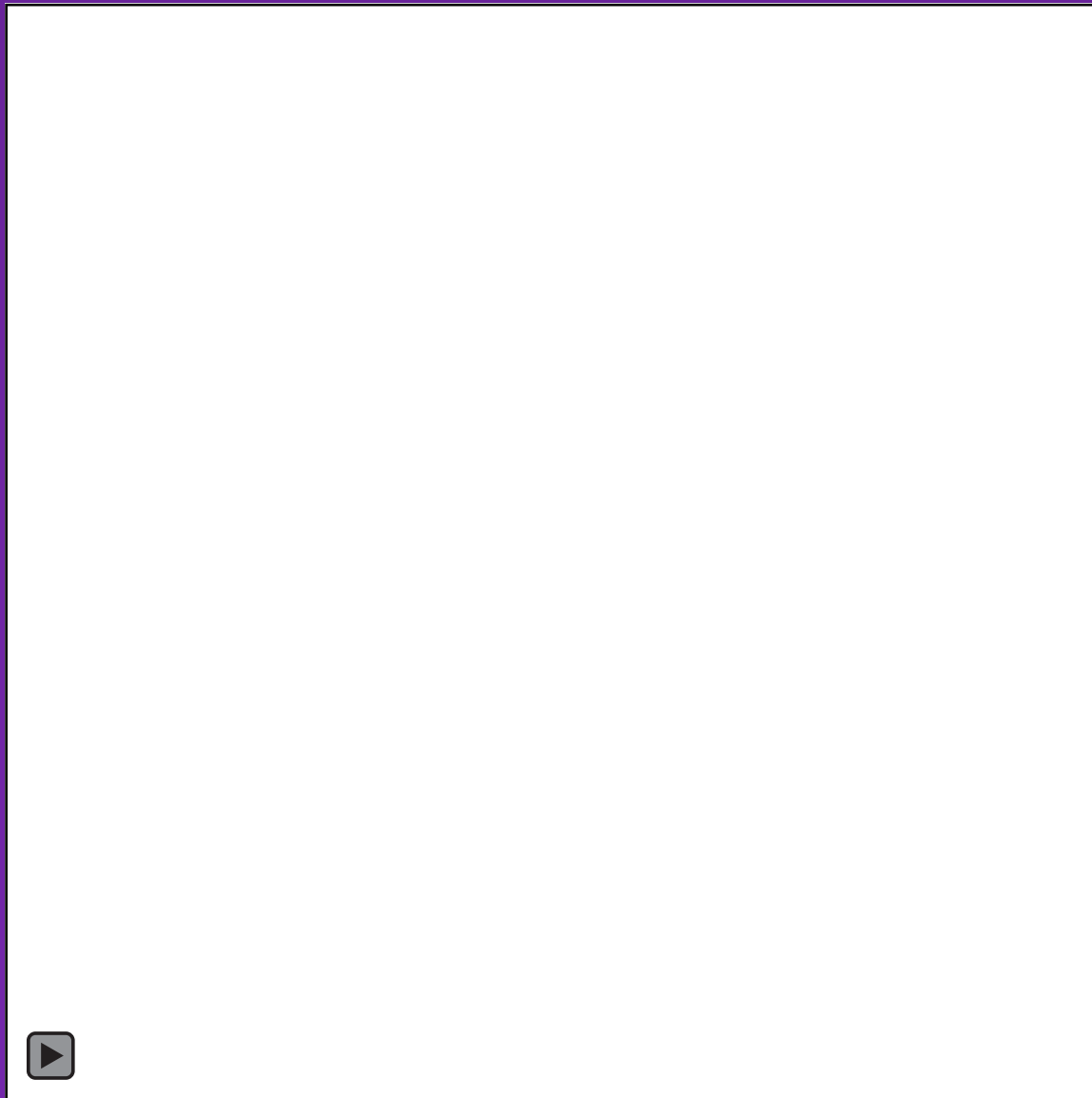


AIA 94

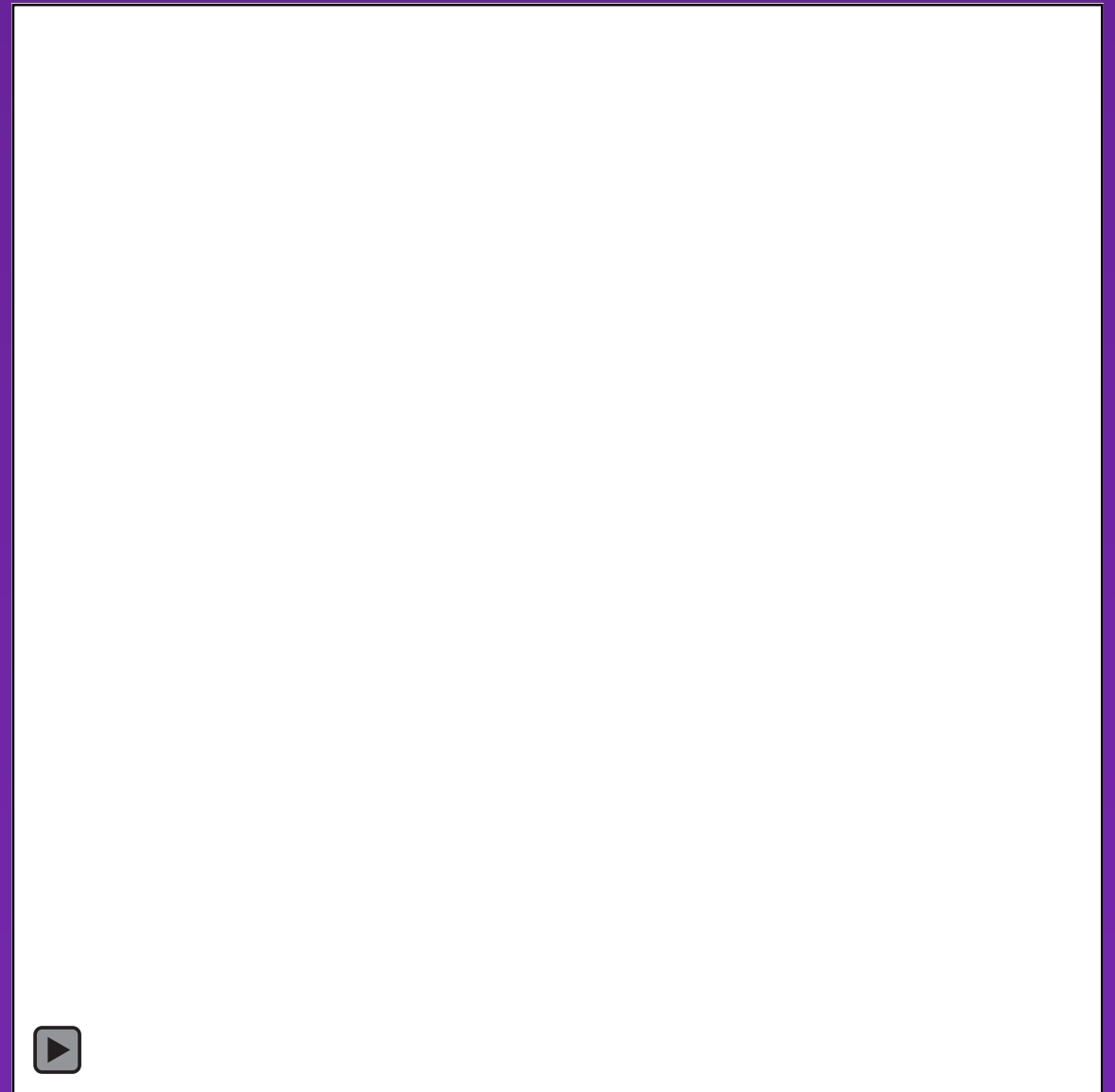


AR Jet Example 2: To investigate further, look at a different AR:

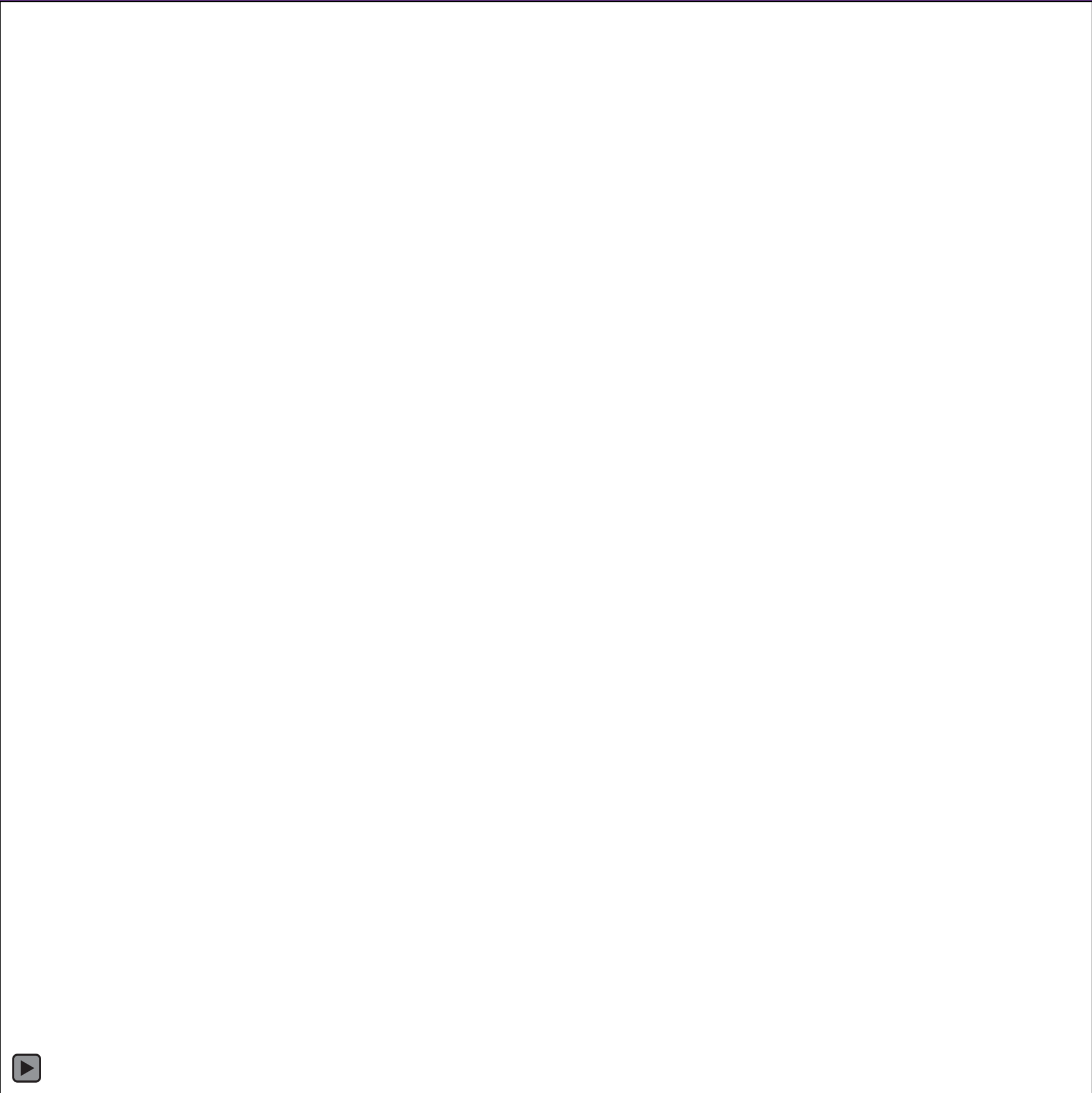
- 14 Jan 2015 (NOAA AR 12259).
- AIA, HMI, Hinode, IRIS

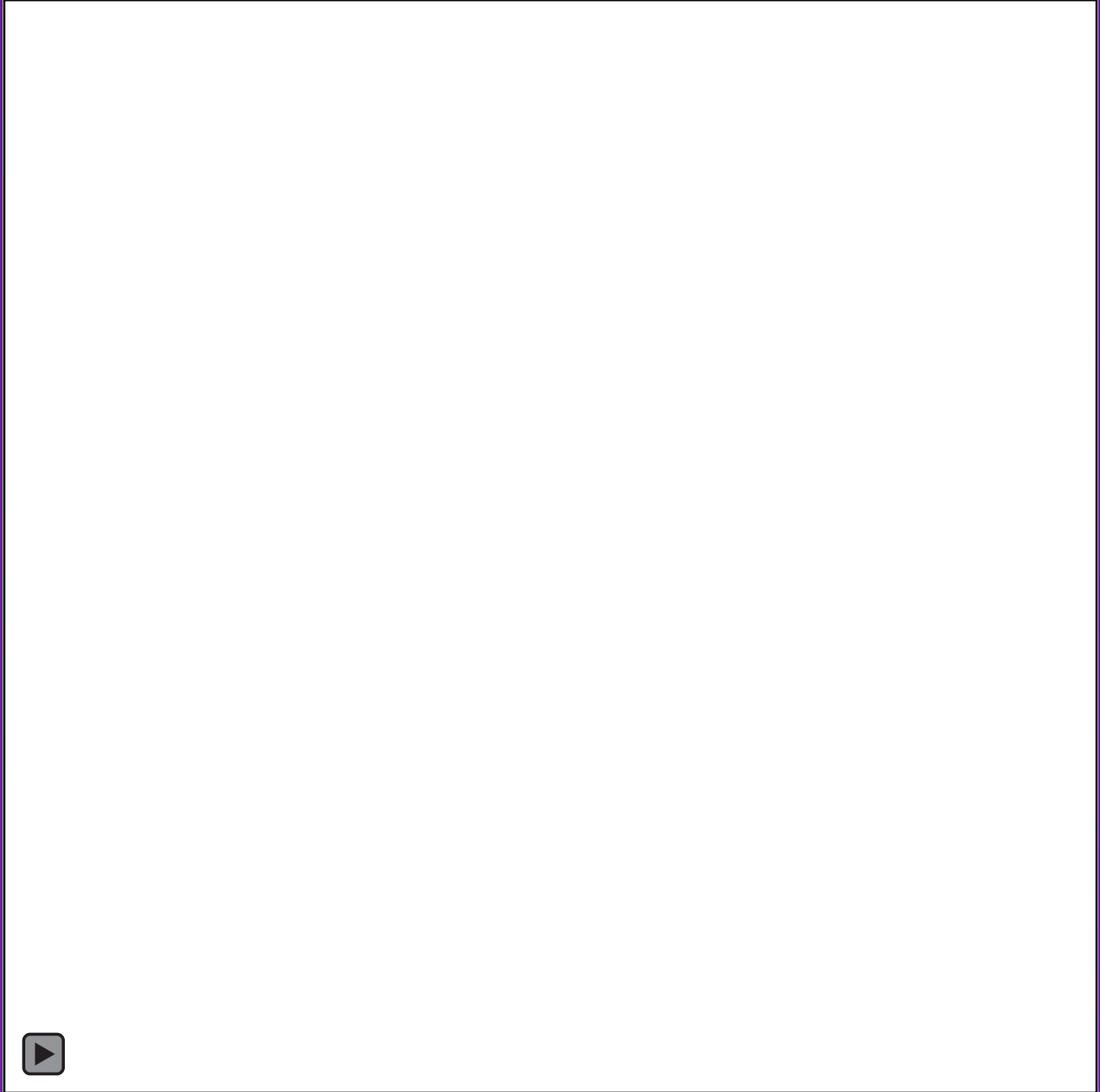


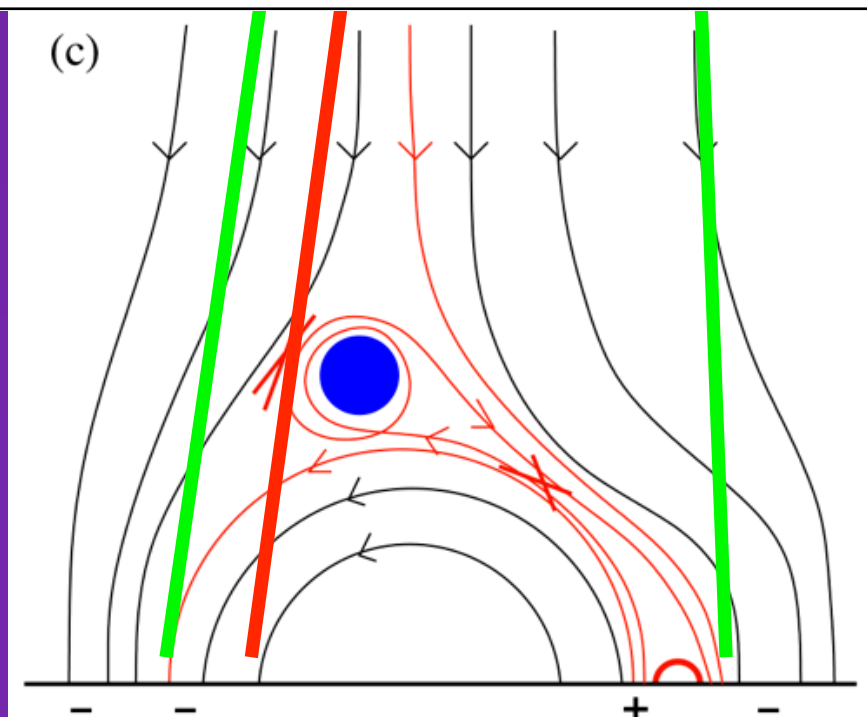
Hinode/XRT



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Flux Cancellation Rates:

Panesar et al. (2016); Sterling et al. (2017):

- For QS jets (~10 events): $\sim 1.5 \times 10^{18}$ Mx/hr (verify)
- For AR jets (~7 events): $\sim 1.5 \times 10^{19}$ Mx/hr